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Evidence from state-dependent fiscal
multipliers in the euro area

George Hondroyannis
Dimitrios Papaoikonomou

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BANK OF GREECE
Economic Analysis and Research Department – Special Studies Division
21, E. Venizelos Avenue
GR-102 50 Athens
Tel: +30210-320 3610
Fax: +30210-320 2432

www.bankofgreece.gr

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WHEN DOES IT PAY TO TAX? EVIDENCE FROM STATE-DEPENDENT FISCAL MULTIPLIERS IN THE EURO AREA

George Hondroyiannis
Bank of Greece and Harokopio University

Dimitrios Papaoikonomou
Bank of Greece

Abstract

The impact of fiscal policy on economic growth is investigated within a panel of euro area member states over the period 2004-2011. We mainly consider fiscal impulses identified by (a) changes in the structural primary balance, complemented by evidence from (b) the IMF narrative shocks developed by Devries *et al* (2011) and (c) a VAR-based measure of unanticipated policy announcements. Aggregate fiscal multipliers are estimated in the region of 0.5, although we find considerable variation depending on the fiscal mix, the degree of openness and the state of the economy. During episodes of recession, tax hikes become significantly more costly in terms of output than expenditure cuts. This appears to be related to increases in the share of hand-to-mouth consumers, proxied by the unemployment rate. Fiscal effects are generally more muted in open economies and during periods of positive growth. Country-specific features in Greece lead to significantly higher estimates, possibly in excess of unity in 2011, reflecting predominantly sizeable revenue effects.

JEL classification: E62, H22, H50

Keywords: Fiscal multipliers, state-dependence, euro area

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Correspondence:

George Hondroyiannis
Economic Analysis and Research Department
Bank of Greece
21, E. Venizelos Avenue,
Athens 102 50, Greece
Tel. +30 210 3202429
Email: ghondroyiannis@bankofgreece.gr

1. Introduction

The long-standing debate regarding the effects of fiscal policy on economic activity has produced a voluminous body of empirical evidence. At the risk of oversimplifying, analyses can be grouped into two broad categories, depending on whether fiscal shocks are (a) generated endogenously, or (b) determined exogenously.

Studies in the first category involve the estimation of dynamic systems, in which policy shocks are identified through various forms of restrictions on the model's dynamics. Recent T-VAR studies (Baum and Koester 2011; Auerbach and Gorodnichenko 2012; Batini et al 2012; Baum, Poplawski-Ribeiro and Weber 2012; Hernandez de Cos and Moral-Benito 2013) allow for threshold non-linearities in the fiscal effect and typically find that spending multipliers increase significantly during periods of economic slack. However, despite introducing parameter flexibility, T-VAR analyses typically rely on the identification scheme proposed by Blanchard and Perotti (2002), which requires an exogenous estimate of the tax elasticity.¹ A more fundamental criticism is that in the presence of "fiscal foresight" the MA representation of the VAR is not invertible and the fiscal shocks are not identified.²

Studies falling under the second category use direct observations on fiscal shocks obtained either through conventional cyclical adjustment, or via the narrative approach. The appeal in this approach lies in that it addresses the "fiscal foresight" critique. However, valid fiscal shocks which are uncontaminated by other fluctuations are difficult to come by and conventional cyclical adjustment is well-documented to be far from perfect.³ Narrative measures, on the other hand, offer an increasingly popular alternative. Recent studies employing narrative fiscal shocks report sizeable revenue multipliers, typically in excess of unity, (Romer and Romer 2010; Mertens and Ravn 2012; Perotti 2012; Cloyne 2013)⁴, while the effects on public spending

¹ Auerbach and Gorodnichenko note that tax elasticities may vary over the cycle and report revenue multipliers to be very sensitive to the assumed elasticity.

² See for example Favero and Giavazzi (2012).

³ See Guajardo et al (2011).

⁴ Less sizeable revenue effects have been reported for the US by Favero and Giavazzi (2012), although their analysis is challenged by Perotti (2012).

tend to be comparatively modest (Ramey and Shapiro 1998; Ramey 2011).⁵ Parameters, however, are typically assumed to be time-invariant.⁶

The purpose of the paper is to estimate the effect of fiscal policy on economic activity combining elements from the two approaches. Hence we consider fiscal impulses identified by (a) changes in the structural primary balance, complemented by evidence from (b) the IMF narrative shocks developed by Devries et al (2011) and (c) a VAR-based measure of unanticipated policy announcements. We employ direct observations on fiscal shocks to provide estimates of state-dependent fiscal multipliers for the euro area, with explicit references to the case of Greece. We simultaneously consider multiple sources of non-linearity, allowing fiscal effects to differ according to exogenously determined states for the degree of openness, the state of the economy and the policy mix.

Apart from a generic interest in the euro area, looking at a currency union has one important practical advantage. As noted, for example, in Guajardo et al (2011) differences in the estimated effects of taxation and government spending could arise due to the conduct of monetary policy. While this may be a valid criticism when monetary policy is set at the national level, in the context of a currency union monetary policy can be convincingly argued not to respond systematically to any individual country's fiscal policy.

Focusing on the euro area, however, also comes at a cost, as it does not allow us to carry out our main analysis using narrative shocks.⁷ Instead, we use the measure of the structural primary balance, providing an informal indication on possible bias using the available narrative shocks. Also, our approach rids us from the curse of dimensionality of VAR analyses, allowing us to include a non-trivial set of control variables.

The rest of the paper is organized as follows: Section 2 presents the main findings, building up from a baseline specification. Section 3 reports robustness

⁵ Guajardo et al (2011) present very similar evidence using narrative panel data on both revenue and spending for 17 OECD member states.

⁶ Owyang et al (2013) have recently introduced threshold effects in an analysis of narrative spending shocks for the US and Canada. They allow the spending multiplier to differ according to a single, exogenously determined threshold in unemployment, finding mixed evidence.

⁷ The single available data source on euro area countries in Devries et al (2011) unfortunately covers only 10 member states (Austria, Belgium, Spain, Finland, Germany, France, Ireland, Italy, Netherlands and Portugal).

checks for panel dimensions and provides an informal comparison with alternative measures of fiscal impulses, generated using the IMF narrative data set. Section 4 concludes.

2. Methodology and Empirical Results

2.1 Baseline specification

We estimate the following baseline specification:

$$Y_{it} = \mu_i + \lambda_t + \delta Y_{i,t-1} + \alpha F_{it} + \boldsymbol{\beta}' \mathbf{X}_{it} + \varepsilon_{it} \quad (1)$$

where Y_{it} is the real GDP growth rate observed for country $i = 1, 2, \dots, M$ during period $t = 1, 2, \dots, T$, μ_i and λ_t are country and period-specific effects, respectively, F_{it} is the fiscal impulse with impact multiplier α , \mathbf{X}_{it} is a k -vector of non-fiscal regressors with constant loadings $\boldsymbol{\beta} = \beta_1, \beta_2, \dots, \beta_k'$, and ε_{it} is a zero-mean error term.

We define the fiscal impulse F_{it} as the annual change in the structural primary balance. We include in \mathbf{X}_{it} the following core variables: (i) economic sentiment growth, (ii) Δ (unemployment rate), (iii) current period and first lag of real credit growth, (iv) trade balance growth rate and (v) Δ (private investment).⁸

Accounting for endogeneity and the lagged dependent variable, equation (1) is estimated with GMM. We apply first-differences in the tradition of Arellano and Bond (1991), hereafter GMM_1, as well as the forward orthogonal deviations proposed by Arellano and Bover (1995), hereafter GMM_2. In both cases, we employ the two-step estimator using White diagonal weighting matrices.⁹ White-period robust standard errors are reported throughout.¹⁰

⁸ Definitions and sources of all variables are provided in the data appendix. All data are collected for EA17 members, namely: Austria, Belgium, Cyprus, Germany, Estonia, Spain, Finland, France, Greece, Ireland, Italy, Luxembourg, Malta, Netherlands, Portugal, Slovenia and Slovakia.

⁹ System GMM is another popular alternative, provided that changes in instrumenting variables are not correlated with fixed effects, e.g. Roodman (2009a). The presence of sizeable output gaps in EA17 during 2004-2011 indicates persistent deviations from steady-state, suggesting that the system GMM assumption is likely to be violated in the period under investigation.

¹⁰ The large number of instruments generated by the GMM estimators is likely to result in downward bias in standard errors, as well as to a weak test of instrument validity, e.g. Roodman (2009b). While the former does not affect the consistency of the estimated parameters, the latter is potentially hazardous. In all cases we report Sargan-test p-values for full instruments and collapsed third-lag instruments.

Estimates of (1) are reported in Table 1 under column I for both GMM_1 and GMM_2. All coefficients are found to be significant and are signed in line with our priors. Both estimators return identical values for $\alpha = -0.34$. However, this estimate does not take account of possible non-linearities arising from the degree of trade openness or the state of the economy, nor does it account for the effect of the policy mix.

2.2 Non-linear fiscal multipliers

We proceed by introducing non-linearity in the fiscal multiplier, allowing for state-dependent estimates. In particular, we reformulate (1) as

$$Y_{it} = \mu_i + \lambda_t + \delta Y_{i,t-1} + \alpha F_{it} + \boldsymbol{\beta}' \mathbf{X}_{it} + \sum_{j=0}^p \gamma_j F_{it} D_{it}^j + \varepsilon_{it} \quad (2)$$

where D_{it}^j is a binary variable taking values of either zero or unity, defining an exogenously determined state j . The γ_j 's capture the marginal effect of state j on the fiscal multiplier α , so that when $D_{it}^j = 1$ the fiscal multiplier is given by the sum $(\alpha + \gamma_j)$.

We expand the baseline \mathbf{X}_{it} to include (vi) debt growth relative to Germany and (vii) $\Delta(\text{coordinated_consolidation})$ and define the following indicator dummies: $D_{it}^0 = \text{spending_based}$, denoting expenditure share of at least $\frac{3}{4}$ in the fiscal mix; $D_{it}^1 = \text{open_economy}$, denoting GDP share of exports plus imports above the EA average; $D_{it}^2 = \text{recession}$, denoting negative real GDP growth. We additionally allow the fiscal multiplier in Greece to be influenced by country-specific factors beyond those captured by trade openness, the fiscal mix and the incidence of recession, by defining the self-explanatory indicator dummies $D_{it}^3 = \text{Greece}$ and $D_{it}^4 = \text{Greece in 2011}$.

Table 1, columns II-VIII report the estimates for both estimators, GMM_1 and GMM_2. Relative debt growth and coordinated consolidation are each found to have distinct negative effects on growth, beyond those explained by the core variables. In addition, we find unambiguous support in favour of non-linear fiscal effects. We find fiscal multipliers to be more muted in open economies, during periods of positive growth and for spending-based fiscal impulses. Both estimators find evidence of significantly more negative fiscal effects in Greece, beyond those captured by D_{it}^0 , D_{it}^1

and D_{it}^2 . GMM_1 also reports a significant and sizeable increase in the fiscal multiplier in the year 2011, although GMM_2 finds no significant effect.

Figure 1 plots the state-dependent effects of a fiscal consolidation by 1% of GDP, based on the estimates reported in Table 1, column VIII under GMM_1. The estimated multipliers are found to be rather muted, although there is considerable variation across different states. Values range from statistically insignificant non-Keynesian effects of less than 0.1, reported in the case of spending-based consolidation in open economies during periods of positive growth, to significant Keynesian effects around -0.5, in the case of non-spending based consolidations undertaken in closed economies during periods of recession. Idiosyncratic features in Greece lead to magnified fiscal effects by an estimated -0.2. Based on GMM_1, the multiplier in Greece exceeded unity in 2011.

2.3 Distinct revenue and expenditure shocks

The effect of the policy mix was captured in the context of (2) by means of the exogenously determined D_{it}^0 . The definition of a spending-based fiscal impulse according to D_{it}^0 , however, is arbitrary and estimates can be sensitive to different definitions. In this section we introduce distinct revenue and expenditure shocks, modifying equation (2) as

$$Y_{it} = \mu_i + \lambda_t + \delta Y_{i,t-1} + \boldsymbol{\beta}' \mathbf{X}_{it} + \alpha_S S_{it} + \alpha_{R,0} R_{i,t} + \alpha_{R,1} R_{i,t-1} + \sum_{j=1}^p \gamma_{S,j} S_{it} D_{it}^j + \sum_{j=1}^p \gamma_{R,j} R_{it} D_{it}^j + \varepsilon_{it} \quad (3)$$

where S_{it} and R_{it} denote spending and revenue shocks, respectively. The coefficients $\gamma_{S,j}$ and $\gamma_{R,j}$, $j = 1, 2, 3$ capture the effects of *open_economy*, *recession* and *Greece* on the impact multipliers of spending and revenue, respectively. Table 2 reports the estimates under GMM_1 and GMM_2 for S_{it} and R_{it} measured by the change in the ECB measures of structural primary expenditure and structural revenue, respectively. Figure 2 illustrates the effects of expenditure and revenue shocks of 1% of GDP, based on the estimates reported in Table 2, column VII under GMM_1.

As in the case of the aggregate fiscal impulse, the use of distinct spending and revenue shocks verify that fiscal effects tend to be larger in closed economies and during episodes of recession. While spending and revenue effects do not display

significant differences during periods of positive growth, the incidence of recession is found to predominantly affect the revenue multiplier, leading to significantly greater revenue effects. Overall, however, estimates remain modest, ranging from statistically insignificant non-Keynesian effects of less than 0.05 in the case of spending shocks in open economies, to significant Keynesian effects of about -0.7 in the case of revenue shocks in closed economies during recessions.

Both estimators verify our earlier finding that the fiscal multiplier in Greece is influenced by country-specific factors beyond those captured by trade openness and the incidence of recession. The use of distinct revenue and spending shocks reveals that the idiosyncratic features of Greece concern predominantly the revenue side, leading to a revenue multiplier of approximately -0.9 during recessions.

2.4 Investigating rising revenue multipliers during recessions

The episodes of recession in our sample cover significant increases in unemployment. Rising unemployment rates can be argued to increase the share of hand-to-mouth consumers, leading to higher marginal propensity to consume. This would tend to magnify the effects of revenue shocks affecting directly disposable income, such as income taxes.¹¹ Furthermore, a rising share of hand-to-mouth consumers may shift consumption preferences towards lower-taxed necessities, increasing the income sensitivity of consumption taxes.

To assess the extent to which our recession estimates are picking out the effects of rising shares of hand-to-mouth consumers, we re-estimate (3) including the indicator dummy D_{it}^4 , which is defined here to pick out observations following episodes of sizeable increases in the unemployment rate, in excess of 1 percentage point. Table 3 summarizes the results. The introduction of unemployment effects renders the coefficients on the recession dummies insignificant, leaving the remaining estimates largely unaffected. In addition, the unemployment effects are found to be very sizeable and significant as regards the revenue multiplier, but seem to have no impact on expenditure. Both of these observations speak in favour of the interpretation given above that, in the sample under consideration, rising revenue

¹¹ See Mankiw (2000). Using micro data from the Consumer Expenditure Survey, Johnson et al (2006) and Parker et al (2011) document a substantial response of household spending, particularly for liquidity-constrained households, to the temporary tax rebates of 2001 and 2008.

multipliers during recessions are likely to reflect rising shares of hand-to-mouth consumers.¹²

Figure 3 illustrates the output response to fiscal shocks of 1% of GDP, based on the estimates in Table 3, column II under GMM_1. Two observations are worth pointing out. First, the incidence of unemployment has a particularly strong magnifying impact on the revenue multiplier, while leaving the spending multiplier largely unaffected.¹³ Second, trade openness is very forgiving when consolidating on the spending side, but it offers very little insulation against revenue shocks when unemployment is on the rise.

In the case of Greece, our estimates confirm a significantly more sizeable revenue multiplier, rising well above unity after severe unemployment episodes. The spending multiplier is considerably smaller, it is only marginally affected by the incidence of unemployment and, according to GMM_2, it is not significantly different from the euro-area estimate.

3 Robustness checks

3.1 Sensitivity to panel dimensions

Figure 4 illustrates the sensitivity of the state-dependent fiscal multipliers at $t = 3$ to the exclusion of individual cross-sections. The vertical axis measures the state-dependent multiplier with 1 and 2 standard error bands, while the horizontal axis indicates the excluded cross-section. Full-sample estimates are denoted by dashed lines and refer to Table 1, column VII under GMM_1. Certain point estimates appear to be sensitive to dropping individual cross-sections. For instance, excluding Estonia significantly reduces the revenue multiplier in closed economies during expansions, while the exclusion of the Netherlands increases significantly the revenue multiplier in open economies. Nevertheless, no single cross-section appears to be driving our

¹² Kaplan and Violante (2014) argue that high marginal propensities to consume need not be restricted to low-income groups, but may also apply to middle-class households, provided the latter have recently converted all of their liquid assets into housing. This could be of relevance, considering that in our sample the decline in economic activity and the rise in unemployment may coincide with the burst of housing bubbles.

¹³ Evidence that unemployment does not significantly affect spending multipliers have recently been reported for the US by Owyang, Ramey and Zubairy (2013), using narrative fiscal impulses over the past century.

overall findings, namely, that fiscal effects are smaller in open economies, on the spending side and during periods of positive growth.

Figure 5 illustrates the robustness of the estimated multipliers to shifting forward the estimation starting date from 2004 to 2005 and to 2006. In all cases, estimation ends in 2011. Differences in the estimated multipliers are clearly found to be statistically insignificant and incremental.

3.2 IMF narrative fiscal shocks

Cyclically adjusted measures of fiscal policy are likely to bias the analysis towards downplaying the contractionary effects of discretionary fiscal consolidation, due to measurement error, reverse causality, or both. This is demonstrated, for example, in Guajardo et al (2011), who compare multipliers obtained using the cyclically adjusted primary balance (CAPB) with multipliers obtained from narrative fiscal shocks constructed in Devries et al (2011). Although the structural primary balance used here is somewhat more refined than the CAPB, the critique of measurement error still holds. Reverse causality issues we expect to be less relevant, due to the employment of GMM.

Figure 6 (left column) reports the output responses based on the IMF narrative fiscal shocks. We use the same specification as Guajardo et al (2011), applying GMM_1. The estimates provide merely a broad indication and are not directly comparable to our main results, as the IMF narrative fiscal shocks are not available for seven euro area members.¹⁴ Error bands are very wide due to the reduced number of observations. Point estimates indicate a very strong revenue effect, cumulating to -1.21 within two years, which is remarkably close to the figure reported by Gujardo et al (2011) (-1.29 at $t = 2$). We find the expenditure effect to be rather muted and largely insignificant after the second period. Based on this very crude comparison we infer that, while under-estimation is possible, it appears to concern mainly the revenue effect.

¹⁴ Cyprus, Estonia, Greece, Luxembourg, Malta, Slovenia and Slovakia.

3.3 VAR-based fiscal innovations

Discretionary fiscal policy need not be orthogonal to information available to economic agents. This is obviously the case whenever policy makers make fiscal adjustments in response to cyclical conditions, which is the source of the reverse causality bias in the case of cyclically adjusted measures of fiscal policy. The same concerns, however, may also apply to shocks identified through the narrative approach, for reasons outlined in Favero and Giavazzi (2012) and in Perotti (2012).

We obtain measures of unanticipated policy announcements by including the IMF narrative policy shocks directly in a panel VAR given by

$$\mathbf{Z}_{it} = \mu_i + \lambda_t + B(L)\mathbf{Z}_{i,t-1} + \varepsilon_{it} \quad (4)$$

where \mathbf{Z}_{it} includes the following variables: Y_{it} , F_{it} , the narrative fiscal shocks, $\Delta(\text{economic sentiment})$, $\Delta(\text{unemployment rate})$, stock market growth and debt growth relative to Germany. The VAR in (4) is estimated for $B(L)$ of order 1 using OLS, allowing for country and period-specific effects μ_i and λ_t . We identify unanticipated fiscal innovations as the Generalized Impulses discussed in Garratt et al (2012) in the equation of F_{it} .

We estimate two versions of (4). The first uses the aggregate narrative fiscal shock F_{it} . In the second, F_{it} is replaced by the distinct narrative revenue and spending shocks, R_{it} and S_{it} , respectively. Figure 6 (middle column) plots the GDP responses to unitary Generalized Impulses in the equations for F_{it} , R_{it} and S_{it} . Similar to the single equation specification discussed above, the responses indicate a sizeable revenue effect in excess of unity and an insignificant spending effect. The equations of the narrative shocks do not involve significant coefficients on lagged output growth, which supports the validity of the narrative approach.

As an additional benchmark, we report multipliers obtained from the VAR in (4), replacing narrative fiscal shocks with $\Delta(\text{structural primary balance})$. The resulting effects are plotted in Figure 6 (right column) and are in line with our overall findings. As expected, the responses appear more muted compared to those obtained using the narrative shocks, which is in line with the evidence reported in Guajardo et al (2011).

4. Concluding Remarks

Our analysis confirms that looking for the value of *the* fiscal multiplier is an elusive quest. Different fiscal instruments can have different effects under different conditions across different economies. During episodes of recession, we find that tax hikes become significantly more costly in terms of output than expenditure cuts. This appears to be related to increases in the share of hand-to-mouth consumers, proxied by the unemployment rate. Fiscal effects are generally more muted in open economies and during periods of positive growth. However, when unemployment is on the rise, trade openness offers very little insulation against revenue shocks.

The use of the structural primary balance is likely to be a source of bias. Based on the reported evidence from the narrative shocks, it appears less likely that we are underestimating the effects of expenditure shocks. The narrative evidence also confirms sizeable revenue effects, in line with the related literature and well above those of spending shocks.

As regards Greece, we find consistent evidence of a sizeable country-specific effect, which originates primarily on the revenue side. Unlike analyses of countries where monetary policy is set at the national level, the estimated difference between revenue and spending multipliers in Greece can safely be regarded not to reflect upon monetary policy. Likely sources include one or more of the following:

- (i) A particularly low degree of openness. Based on our measure of openness, Greece has systematically ranked among the three least open economies within the sample. However, the fact that the country-specific effect originates mainly from the revenue side suggests that it is more likely to reflect:
- (ii) The severity of the recent unemployment episodes, and/or
- (iii) Country-specific features of tax evasion, which tend to increase income inequality, shifting the tax burden to low-income groups with high marginal propensity to consume.¹⁵

As a final remark, it is important to point out that, just like the concept of *the* multiplier, is misleading, so is the dilemma between revenue and spending. As evidenced in DSGE studies, *the* revenue and *the* spending multipliers may conceal

¹⁵ Pappa et al (2014) illustrate that tax hikes become substantially more costly than spending cuts in the presence of tax-evasion and corruption, which is argued to be particularly relevant in the case Greece.

significant differences between individual revenue and expenditure instruments.¹⁶ In answering the title question, our evidence suggests “not when unemployment is on the rise”.

¹⁶ See Coenen et al (2012) and for the case of Greece, Philippopoulos et al (2012) and Papageorgiou (2012).

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Data Appendix

Variable	Description		Source
Real GDP growth rate	annual growth rate (%)		Eurostat
Structural primary balance	% of trend GDP. Defined as cyclically adjusted primary balance excluding temporary measures.		ECB, WGPF
Structural primary expenditure	% of trend GDP. Defined as cyclically adjusted expenditure excluding interest payments and temporary measures.		ECB, WGPF
Structural revenue	% of trend GDP. Defined as cyclically adjusted revenue excluding temporary measures.		ECB, WGPF
Economic Sentiment	annual growth rate (%). For Ireland the Consumer Confidence Indicator is used instead due to unavailability of ESI.		DG ECFIN
Unemployment rate	annual average (%)		Eurostat
Real credit growth rate	Domestic credit to private sector deflated by the GDP deflator (annual growth rate)		WDI
Private investment	Total gross fixed capital formation less government gross fixed capital formation (% of GDP)		Eurostat
Trade balance	% of GDP		Eurostat
Coordinated Consolidation	Calculated as the % of euro area countries with $\Delta(\text{structural primary balance}) > 0$, excluding country i .		ECB, WGPF
Relative Debt	Government consolidated gross debt in country i (in % of GDP) relative to Germany		Eurostat
Stock market index	Share price indices (rebased) - annual data, 2005=100. Deflated by the GDP deflator.		Eurostat
List of Instruments			
Variable	Lag	Description	Source
Real GDP growth rate	2-12	annual growth rate (%)	Eurostat
Structural primary balance	2	% of trend GDP. Defined as cyclically adjusted primary balance excluding temporary measures.	ECB, WGPF
Structural primary expenditure	2	% of trend GDP. Defined as cyclically adjusted expenditure excluding interest payments and temporary measures.	ECB, WGPF
Structural revenue	2	% of trend GDP. Defined as cyclically adjusted revenue excluding temporary measures.	ECB, WGPF
Economic Sentiment	1-2	annual growth rate (%). For Ireland the Consumer Confidence Indicator is used instead due to unavailability of ESI.	DG ECFIN
Unemployment rate	3-4	annual average (%)	Eurostat
Real credit growth rate	4	Domestic credit provided by banking sector deflated by the GDP deflator (annual growth rate)	WDI
Trade balance	2,3	% of GDP	Eurostat
Average austerity	2,3	Average value of $\Delta(\text{structural primary balance})$ across EA17 countries excluding country i , in % of trend GDP.	ECB, WGPF
Private investment	3	Total gross fixed capital formation less government gross fixed capital formation (% of GDP)	Eurostat
Relative Debt	2	Government consolidated gross debt in country i (in % of GDP) relative to Germany	Eurostat

Table 1 – Model with Aggregate Fiscal Shock measured by Δ (Structural Primary Balance)

Dependent variable: Real GDP growth rate									Sample: 2004-2011, Observations: 122, Cross-sections: 17							
Estimator	GMM_1								GMM_2							
	I	II	III	IV	V	VI	VII	VIII	I	II	III	IV	V	VI	VII	VIII
(Real GDP growth rate) _{t-1}	-0.26 *** (0.03)	-0.22 *** (0.03)	-0.23 *** (0.02)	-0.19 *** (0.03)	-0.21 *** (0.02)	-0.18 *** (0.02)	-0.08 *** (0.02)	-0.09 *** (0.01)	-0.04 *** (0.02)	0.01 (0.02)	-0.10 *** (0.02)	-0.02 (0.02)	0.04 (0.03)	-0.03 ** (0.01)	0.04 ** (0.02)	0.06 *** (0.02)
Δ (Structural Primary Balance)	-0.34 *** (0.03)	-0.31 *** (0.05)	-0.36 *** (0.04)	-0.49 *** (0.04)	-0.37 *** (0.03)	-0.13 *** (0.03)	-0.37 *** (0.05)	-0.35 *** (0.04)	-0.34 *** (0.02)	-0.28 *** (0.03)	-0.39 *** (0.03)	-0.44 *** (0.03)	-0.41 *** (0.04)	-0.15 *** (0.02)	-0.36 *** (0.03)	-0.33 *** (0.02)
Economic Sentiment growth rate	0.07 *** (0.01)	0.07 *** (0.01)	0.08 *** (0.01)	0.09 *** (0.01)	0.09 *** (0.01)	0.09 *** (0.01)	0.12 *** (0.01)	0.11 *** (0.01)	0.12 *** (0.00)	0.13 *** (0.00)	0.13 *** (0.01)	0.14 *** (0.00)	0.16 *** (0.00)	0.14 *** (0.00)	0.18 *** (0.01)	0.18 *** (0.01)
Δ (unemployment rate)	-0.51 *** (0.11)	-0.38 *** (0.10)	-0.41 *** (0.14)	-0.80 *** (0.05)	-0.52 *** (0.07)	-0.45 *** (0.08)	-0.41 *** (0.11)	-0.28 *** (0.09)	-0.71 *** (0.04)	-0.55 *** (0.06)	-0.71 *** (0.05)	-0.82 *** (0.04)	-0.67 *** (0.04)	-0.63 *** (0.03)	-0.59 *** (0.04)	-0.56 *** (0.06)
Real credit growth rate	0.07 *** (0.01)	0.06 *** (0.01)	0.06 *** (0.01)	0.07 *** (0.01)	0.06 *** (0.01)	0.07 *** (0.01)	0.05 *** (0.01)	0.07 *** (0.01)	0.05 *** (0.01)	0.04 *** (0.01)	0.06 *** (0.01)	0.07 *** (0.01)	0.05 *** (0.01)	0.07 *** (0.01)	0.06 *** (0.00)	0.06 *** (0.01)
(Real credit growth rate) _{t-1}	0.07 *** (0.01)	0.08 *** (0.01)	0.05 *** (0.02)	0.03 *** (0.01)	0.06 *** (0.01)	0.06 *** (0.01)	0.02 * (0.01)	0.03 *** (0.01)	0.05 *** (0.01)	0.05 *** (0.01)	0.04 *** (0.01)	0.04 *** (0.00)	0.05 *** (0.00)	0.04 *** (0.01)	0.03 *** (0.00)	0.03 *** (0.01)
Trade balance growth rate	0.07 *** (0.01)	0.06 *** (0.01)	0.06 *** (0.01)	0.03 ** (0.02)	0.04 *** (0.01)	0.06 *** (0.01)	0.05 *** (0.01)	0.05 *** (0.01)	0.03 ** (0.01)	0.03 (0.02)	0.03 *** (0.01)	0.03 *** (0.01)	0.05 *** (0.02)	0.03 *** (0.01)	0.03 *** (0.01)	0.03 *** (0.01)
Δ (private investment)	0.51 *** (0.02)	0.53 *** (0.03)	0.56 *** (0.03)	0.45 *** (0.04)	0.47 *** (0.02)	0.52 *** (0.03)	0.47 *** (0.03)	0.48 *** (0.02)	0.51 *** (0.04)	0.47 *** (0.05)	0.50 *** (0.05)	0.45 *** (0.03)	0.45 *** (0.03)	0.47 *** (0.04)	0.44 *** (0.03)	0.45 *** (0.04)
Relative debt growth rate		-0.02 *** (0.00)					-0.02 *** (0.00)	-0.02 *** (0.00)		-0.03 *** (0.01)					-0.02 *** (0.00)	-0.02 *** (0.00)
Δ (coordinated_consolidation)			-0.05 *** (0.01)				-0.03 *** (0.00)	-0.03 *** (0.01)			-0.04 *** (0.01)				-0.03 *** (0.00)	-0.03 *** (0.01)
Open_Economy* Δ (Structural Primary Balance)				0.44 *** (0.05)			0.35 *** (0.08)	0.27 *** (0.06)				0.43 *** (0.06)			0.30 *** (0.03)	0.28 *** (0.04)
Spending_based* Δ (Structural Primary Balance)					0.29 *** (0.03)		0.21 *** (0.05)	0.15 *** (0.03)					0.60 *** (0.05)		0.30 *** (0.05)	0.28 *** (0.05)
Recession* Δ (Structural Primary Balance)						-0.31 *** (0.04)	-0.17 *** (0.06)	-0.15 *** (0.05)						-0.29 *** (0.03)	-0.15 *** (0.03)	-0.18 *** (0.03)
Greece* Δ (Structural Primary Balance)								-0.21 *** (0.04)								-0.16 *** (0.02)
Greece*y2011* Δ (Structural Primary Balance)								-0.47 *** (0.07)								-0.02 (0.09)
<i>Test Statistics</i>																
Period dummies redundant (p-value)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sargan test (p-value)																
all instruments	0.28	0.21	0.36	0.37	0.43	0.19	0.40	0.56	0.30	0.34	0.42	0.29	0.33	0.41	0.46	0.36
collapsed instruments	0.23	0.32	0.13	0.23	0.37	0.40	0.46	0.44	0.29	0.32	0.22	0.26	0.22	0.42	0.33	0.24
Instrument rank																
all instruments	105	105	105	105	105	105	105	105	105	105	105	105	105	105	105	105
collapsed instruments	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54

Notes: GMM_1 denotes Arellano Bond (first differences) 2-stage with White diagonal weights. GMM_2 denotes Arellano Bover (forward orthogonal deviations) 2-stage with White diagonal weights. Significance is indicated by “*”, “**” and “***” at the 10%, 5% and 1% levels respectively. White period robust standard errors in brackets. “Coordinated_consolidation” is the % of euro area member states, other than country *i*, registering an improvement in their structural primary balance. “Open_economy” indicates GDP share of exports plus imports above the EA17 average. “Spending_based” denotes that the change in structural primary spending accounts for at least ¼ of the total change in the structural primary balance. “Recession” denotes real GDP growth < 0.

Table 2 – Model with distinct spending and revenue shocks measured by $\Delta(\text{Structural Primary Spending})$ and $\Delta(\text{Structural Revenue})$

Dependent variable: Real GDP growth rate		Sample: 2004-2011, Observations: 122, Cross-sections: 17													
Estimator	GMM_1							GMM_2							
	I	II	III	IV	V	VI	VII	I	II	III	IV	V	VI	VII	
(Real GDP growth rate) _{t-1}	-0.27 *** (0.01)	-0.22 *** (0.03)	-0.27 *** (0.02)	-0.23 *** (0.02)	-0.24 *** (0.02)	-0.12 *** (0.03)	-0.14 *** (0.02)	-0.05 ** (0.02)	-0.00 (0.02)	-0.10 *** (0.03)	-0.01 (0.02)	-0.03 *** (0.01)	0.00 (0.02)	-0.01 (0.02)	
$\Delta(\text{Structural Primary Spending})$	0.33 *** (0.07)	0.39 *** (0.06)	0.35 *** (0.08)	0.49 *** (0.05)	0.23 *** (0.05)	0.32 *** (0.06)	0.29 *** (0.05)	0.25 *** (0.04)	0.23 *** (0.03)	0.28 *** (0.04)	0.46 *** (0.03)	0.12 *** (0.02)	0.36 *** (0.03)	0.28 *** (0.03)	
$\Delta(\text{Structural Revenue})$	-0.42 *** (0.04)	-0.38 *** (0.04)	-0.42 *** (0.05)	-0.44 *** (0.06)	-0.21 *** (0.05)	-0.26 *** (0.05)	-0.25 *** (0.03)	-0.33 *** (0.04)	-0.27 *** (0.02)	-0.41 *** (0.04)	-0.39 *** (0.04)	-0.07 ** (0.03)	-0.23 *** (0.03)	-0.17 *** (0.03)	
$\Delta(\text{Structural Revenue})_{t-1}$	-0.33 *** (0.03)	-0.28 *** (0.04)	-0.33 *** (0.03)	-0.28 *** (0.04)	-0.26 *** (0.03)	-0.19 *** (0.04)	-0.17 *** (0.03)	-0.16 *** (0.04)	-0.17 *** (0.02)	-0.18 *** (0.05)	-0.10 ** (0.04)	-0.12 *** (0.03)	-0.09 ** (0.04)	-0.10 ** (0.04)	
Economic Sentiment growth rate	0.08 *** (0.01)	0.08 *** (0.01)	0.09 *** (0.01)	0.10 *** (0.00)	0.10 *** (0.01)	0.12 *** (0.01)	0.12 *** (0.00)	0.13 *** (0.01)	0.13 *** (0.00)	0.14 *** (0.00)	0.15 *** (0.01)	0.16 *** (0.00)	0.17 *** (0.01)	0.17 *** (0.01)	
$\Delta(\text{unemployment rate})$	-0.59 *** (0.07)	-0.46 *** (0.05)	-0.55 *** (0.07)	-0.61 *** (0.07)	-0.50 *** (0.07)	-0.39 *** (0.07)	-0.37 *** (0.05)	-0.75 *** (0.07)	-0.64 *** (0.05)	-0.77 *** (0.11)	-0.84 *** (0.08)	-0.60 *** (0.05)	-0.59 *** (0.04)	-0.60 *** (0.05)	
Real credit growth rate	0.07 *** (0.01)	0.05 *** (0.01)	0.07 *** (0.01)	0.07 *** (0.01)	0.07 *** (0.01)	0.05 *** (0.01)	0.06 *** (0.01)	0.05 *** (0.01)	0.02 *** (0.01)	0.05 *** (0.01)	0.04 *** (0.01)	0.05 *** (0.01)	0.05 *** (0.00)	0.04 *** (0.00)	
(Real credit growth rate) _{t-1}	0.07 *** (0.01)	0.08 *** (0.01)	0.07 *** (0.01)	0.04 *** (0.01)	0.07 *** (0.01)	0.03 *** (0.01)	0.04 *** (0.01)	0.06 *** (0.01)	0.06 *** (0.00)	0.05 *** (0.01)	0.05 *** (0.01)	0.05 *** (0.00)	0.04 *** (0.00)	0.04 *** (0.01)	
Trade balance growth rate	0.05 *** (0.01)	0.05 *** (0.01)	0.05 *** (0.01)	0.04 *** (0.01)	0.05 *** (0.01)	0.04 *** (0.01)	0.04 *** (0.01)	0.03 *** (0.01)	0.03 *** (0.01)	0.03 *** (0.00)	0.04 *** (0.01)	0.03 *** (0.01)	0.03 *** (0.01)	0.03 *** (0.01)	
$\Delta(\text{private investment})$	0.50 *** (0.02)	0.55 *** (0.03)	0.51 *** (0.03)	0.50 *** (0.02)	0.47 *** (0.03)	0.51 *** (0.04)	0.48 *** (0.02)	0.49 *** (0.06)	0.45 *** (0.03)	0.48 *** (0.05)	0.49 *** (0.02)	0.47 *** (0.04)	0.48 *** (0.02)	0.47 *** (0.03)	
Relative debt growth rate		-0.02 *** (0.00)				-0.02 *** (0.00)	-0.02 *** (0.00)		-0.03 *** (0.00)				-0.02 *** (0.00)	-0.02 *** (0.00)	
$\Delta(\text{coordinated_consolidation})$			-0.02 * (0.01)			-0.01 (0.01)	-0.01 *** (0.00)			-0.04 *** (0.01)			-0.03 *** (0.00)	-0.03 *** (0.00)	
Open_Economy* $\Delta(\text{Structural Primary Spending})$				-0.37 *** (0.08)		-0.42 *** (0.08)	-0.33 *** (0.05)				-0.49 *** (0.06)		-0.43 *** (0.04)	-0.32 *** (0.04)	
Open_Economy* $\Delta(\text{Structural Revenue})$				0.28 *** (0.07)		0.35 *** (0.05)	0.29 *** (0.05)				0.20 *** (0.05)		0.25 *** (0.03)	0.14 *** (0.04)	
Recession* $\Delta(\text{Structural Primary Spending})$					0.07 (0.06)	0.15 *** (0.04)	0.07 (0.06)					0.02 (0.04)	0.10 ** (0.05)	0.03 (0.04)	
Recession* $\Delta(\text{Structural Revenue})$					-0.51 *** (0.09)	-0.35 *** (0.08)	-0.40 *** (0.06)					-0.83 *** (0.05)	-0.46 *** (0.12)	-0.42 *** (0.12)	
Greece* $\Delta(\text{Structural Primary Spending})$							0.12 * (0.06)							0.08 (0.05)	
Greece* $\Delta(\text{Structural Revenue})$							-0.26 *** (0.07)							-0.38 *** (0.07)	
<i>Test Statistics</i>															
Period dummies redundant (p-value)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
$\Delta(\text{Structural Primary Spending})_{t-1}$ redundant (p-value)	0.70	0.03	0.10	0.05	0.07	0.08	0.59	0.66	0.11	0.05	0.41	0.06	0.26	0.90	
Sargan test (p-value)															
all instruments	0.54	0.38	0.37	0.57	0.56	0.50	0.56	0.31	0.44	0.21	0.37	0.48	0.34	0.30	
collapsed instruments	0.38	0.32	0.37	0.60	0.57	0.50	0.36	0.20	0.25	0.16	0.39	0.39	0.36	0.27	
Instrument rank															
all instruments	114	114	113	114	114	114	114	114	114	114	114	114	114	114	
collapsed instruments	55	55	55	55	55	55	55	55	55	55	55	55	55	55	

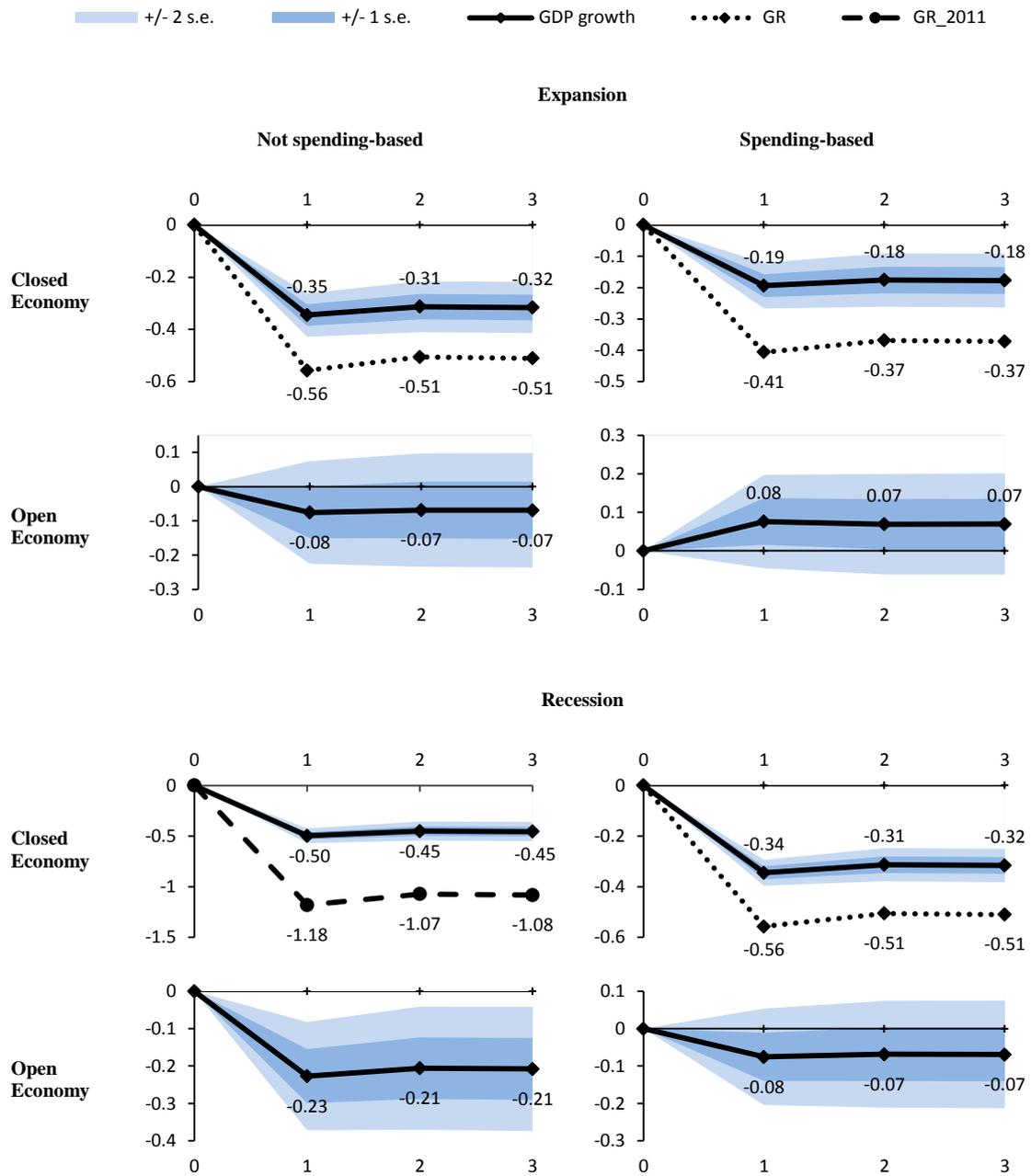
Notes: GMM_1 denotes Arellano Bond (first differences) 2-stage with White diagonal weights. GMM_2 denotes Arellano Bover (forward orthogonal deviations) 2-stage with White diagonal weights. Significance is indicated by “*”, “**” and “***” at the 10%, 5% and 1% levels respectively. White period robust standard errors in brackets. “Coordinated_consolidation” is the % of euro area member states, other than country *i*, registering an improvement in their structural primary balance. “Open_economy” indicates GDP share of exports plus imports above the EA17 average. “Recession” denotes real GDP growth < 0.

Table 3 – Introducing unemployment effects in the Model with distinct spending and revenue shocks in Table 2

Dependent variable: Real GDP growth rate		Sample: 2004-2011, Observations: 122, Cross-sections: 17			
Estimator	GMM_1		GMM_2		
	I	II	I	II	
(Real GDP growth rate) _{t-1}	-0.15 *** (0.02)	-0.15 *** (0.02)	-0.06 * (0.03)	-0.07 ** (0.03)	
Δ(Structural Primary Spending)	0.27 *** (0.04)	0.26 *** (0.03)	0.26 *** (0.04)	0.29 *** (0.05)	
Δ(Structural Revenue)	-0.29 *** (0.03)	-0.29 *** (0.03)	-0.18 *** (0.02)	-0.20 *** (0.02)	
Δ(Structural Revenue) _{t-1}	-0.26 *** (0.05)	-0.25 *** (0.03)	-0.18 *** (0.04)	-0.20 *** (0.03)	
Economic Sentiment growth rate	0.10 *** (0.00)	0.10 *** (0.00)	0.16 *** (0.01)	0.16 *** (0.00)	
Δ(unemployment rate)	-0.53 *** (0.09)	-0.51 *** (0.08)	-0.75 *** (0.07)	-0.75 *** (0.06)	
Real credit growth rate	0.06 *** (0.01)	0.06 *** (0.01)	0.05 *** (0.01)	0.05 *** (0.01)	
(Real credit growth rate) _{t-1}	0.04 *** (0.01)	0.04 *** (0.01)	0.05 *** (0.01)	0.04 *** (0.00)	
Trade balance growth rate	0.05 *** (0.01)	0.05 *** (0.01)	0.04 *** (0.01)	0.03 ** (0.02)	
Δ(private investment)	0.49 *** (0.03)	0.50 *** (0.02)	0.48 *** (0.04)	0.48 *** (0.03)	
Relative debt growth rate	-0.02 *** (0.00)	-0.02 *** (0.00)	-0.03 *** (0.00)	-0.03 *** (0.01)	
Δ(coordinated_consolidation)	-0.03 *** (0.01)	-0.03 *** (0.00)	-0.02 *** (0.01)	-0.02 *** (0.01)	
Open_Economy*Δ(Structural Primary Spending)	-0.15 ** (0.06)	-0.17 *** (0.06)	-0.32 *** (0.06)	-0.36 *** (0.06)	
Open_Economy*Δ(Structural Revenue)	0.14 (0.11)	0.15 ** (0.07)	0.08 (0.06)	0.07 (0.05)	
Recession*Δ(Structural Primary Spending)	-0.06 (0.08)		-0.03 (0.04)		
Recession*Δ(Structural Revenue)	0.01 (0.14)		-0.19 (0.13)		
Greece*Δ(Structural Primary Spending)	0.20 ** (0.09)	0.17 ** (0.08)	0.00 (0.07)	-0.02 (0.06)	
Greece*Δ(Structural Revenue)	-0.40 *** (0.08)	-0.39 *** (0.06)	-0.43 *** (0.08)	-0.47 *** (0.06)	
[Δ(Unemployment rate) _{t-1} > 1]*Δ(Structural Primary Spending)	0.05 (0.06)	0.06 (0.06)	0.07 (0.08)	0.11 (0.06)	
[Δ(Unemployment rate) _{t-1} > 1]*Δ(Structural Revenue)	-0.75 *** (0.17)	-0.70 *** (0.12)	-0.64 *** (0.13)	-0.68 *** (0.10)	
<i>Test Statistics</i>					
Period dummies redundant (p-value)	0.00	0.00	0.00	0.00	
Δ(Structural Primary Spending) _{t-1} redundant (p-value)	0.13	0.08	0.33	0.20	
Recession coefficients redundant (p-value)	0.73		0.27		
Sargan test (p-value)					
all instruments	0.58	0.62	0.26	0.35	
collapsed instruments	0.36	0.31	0.34	0.44	
Instrument rank					
all instruments	114	114	114	113	
collapsed instruments	55	55	55	55	

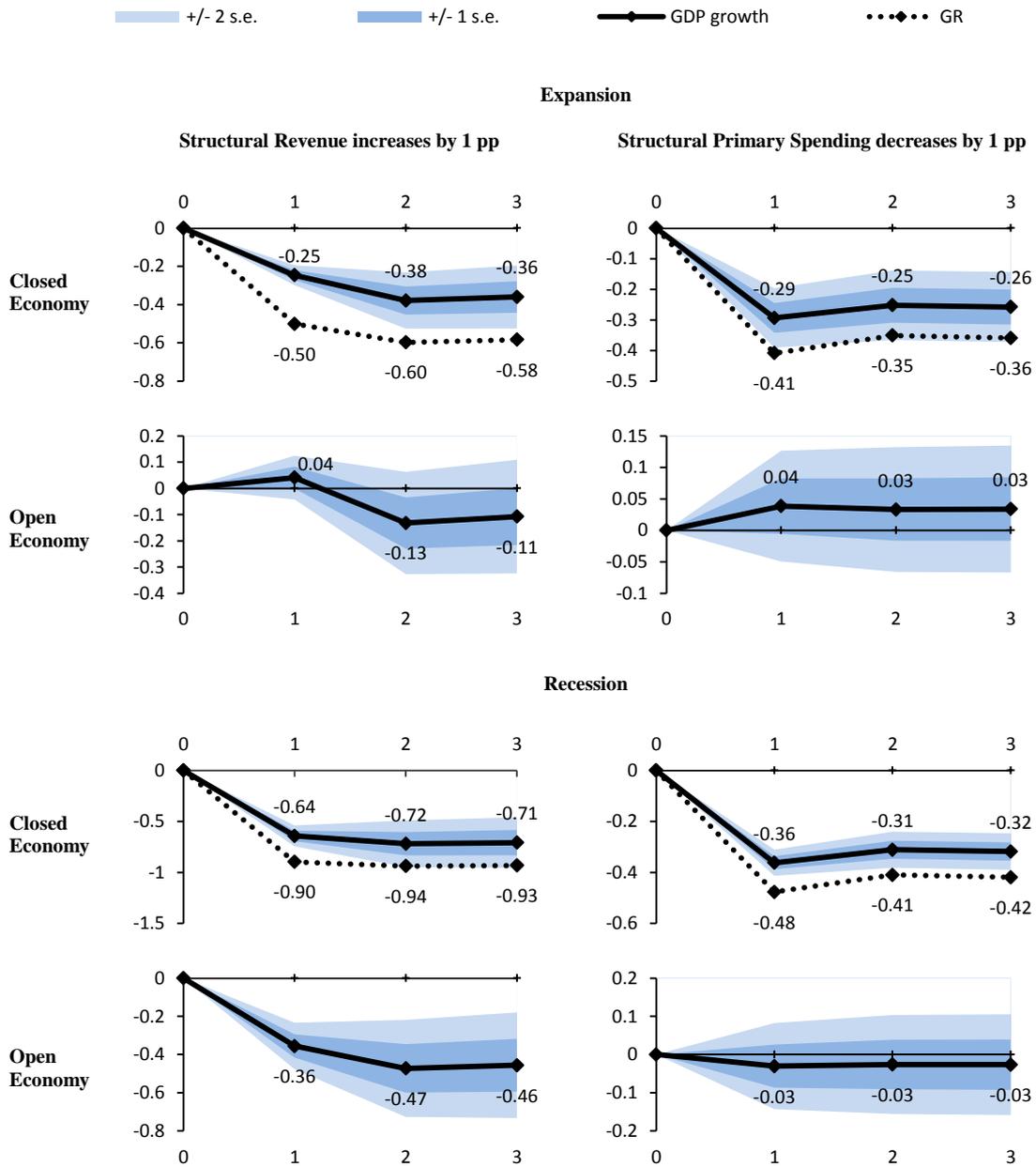
Notes: GMM_1 denotes Arellano Bond (first differences) 2-stage with White diagonal weights. GMM_2 denotes Arellano Bover (forward orthogonal deviations) 2-stage with White diagonal weights. Significance is indicated by “*”, “**” and “***” at the 10%, 5% and 1% levels respectively. White period robust standard errors in brackets. “Coordinated_consolidation” is the % of euro area member states, other than country *i*, registering an improvement in their structural primary balance. “Open_economy” indicates GDP share of exports plus imports above the EA17 average.

Figure 1 – Cumulative response of real GDP growth to a 1 pp improvement in the Structural Primary Balance
 (Estimated in Table 1, GMM_1, column VIII)



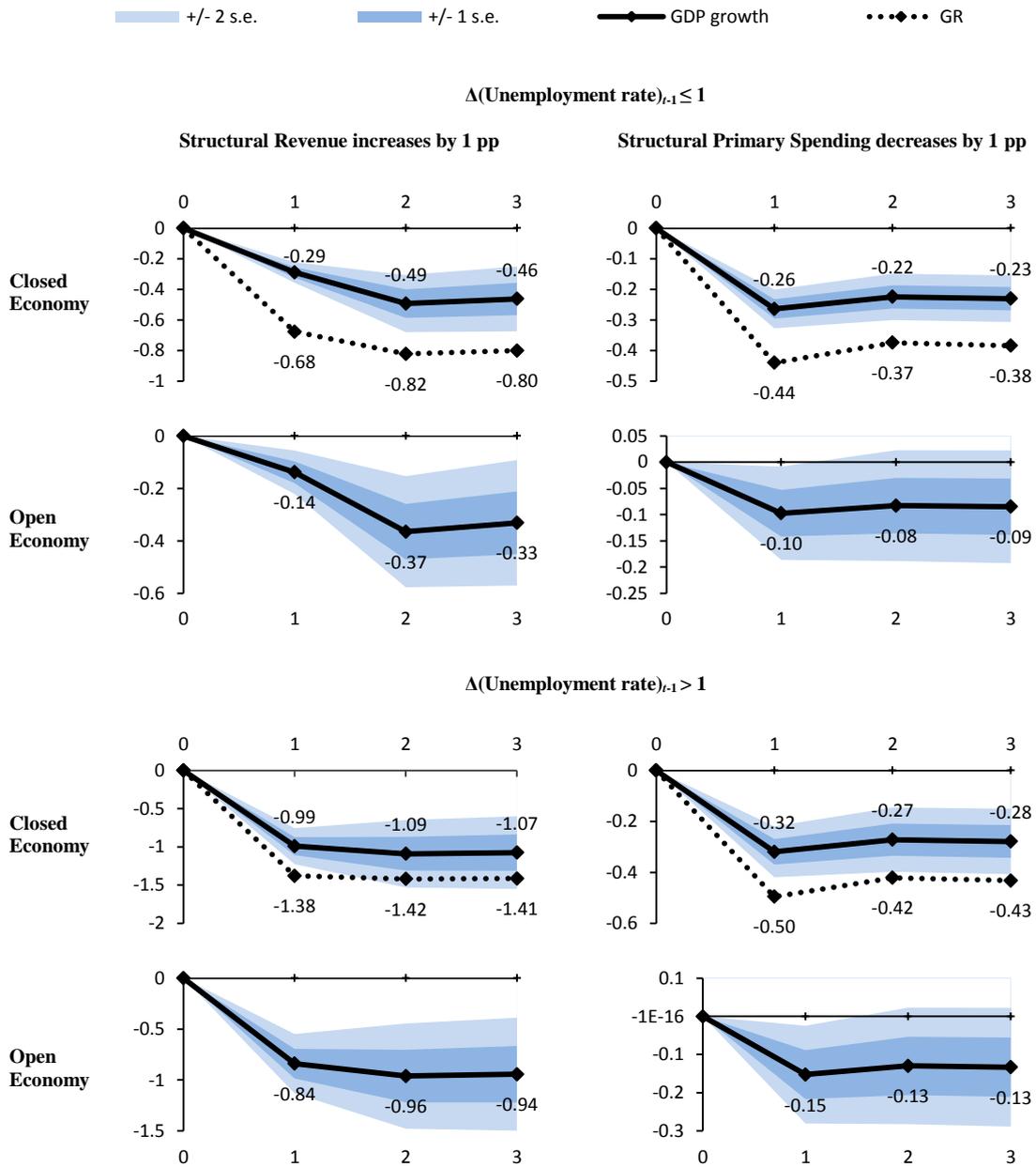
Notes: Open economy if the GDP share of exports plus imports exceeds the euro area average. Spending-based if the change in structural primary spending accounts for at least 3/4 of the total change in the structural primary balance. Recession when real GDP growth < 0.

Figure 2 – Cumulative response of real GDP growth to a 1 pp shock in Structural Primary Spending/Revenue
 (Estimated in Table 2, GMM_1, column VII)



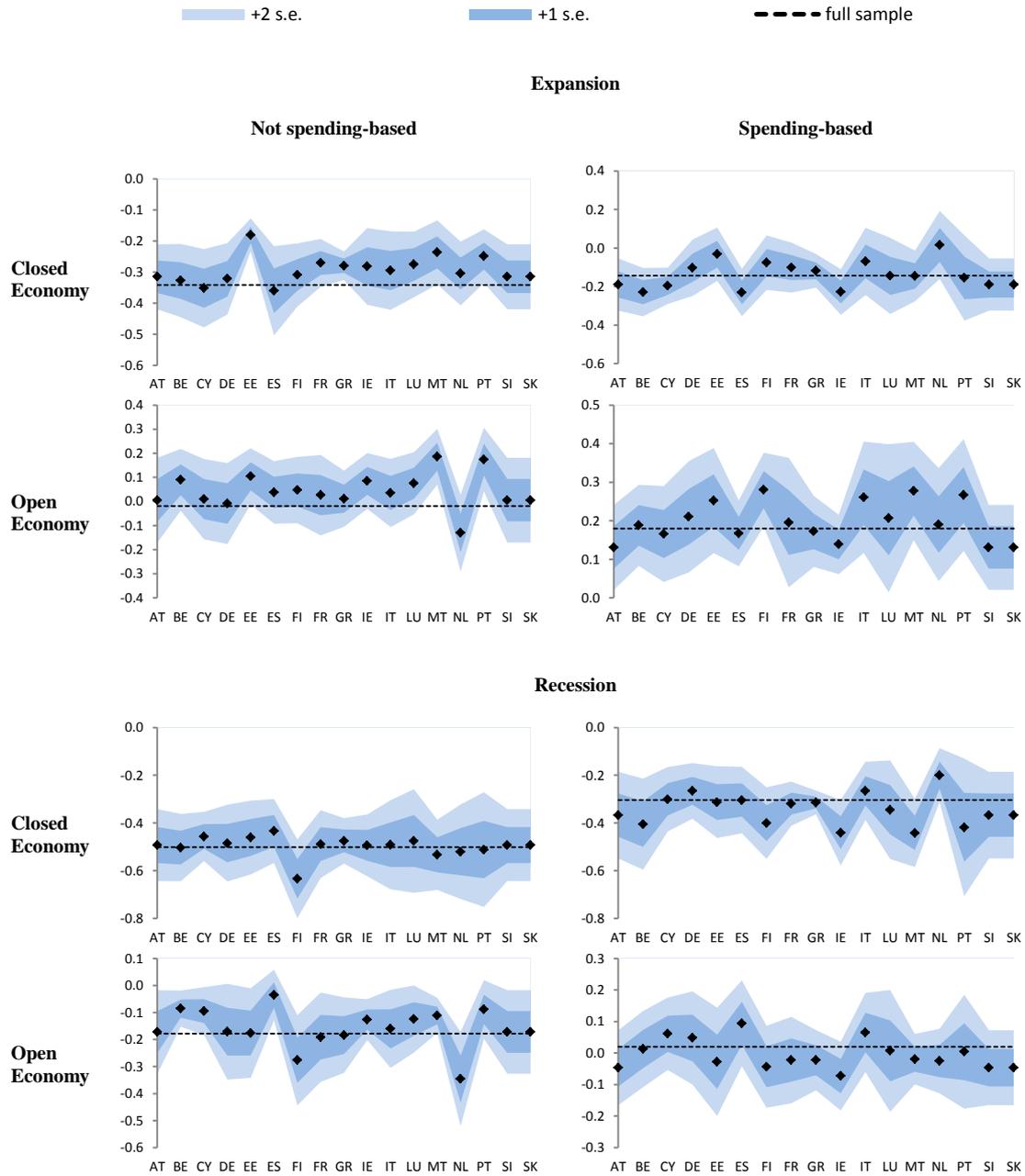
Notes: Open economy if the GDP share of exports plus imports exceeds the euro area average. Recession when real GDP growth < 0.

Figure 3 – Cumulative response of real GDP growth to a 1 pp shock in Structural Primary Spending/Revenue
 (Estimated in Table 3, GMM_1, column II)



Notes: Open economy if the GDP share of exports plus imports exceeds the euro area average. Large increases in unemployment Recession when real GDP growth < 0.

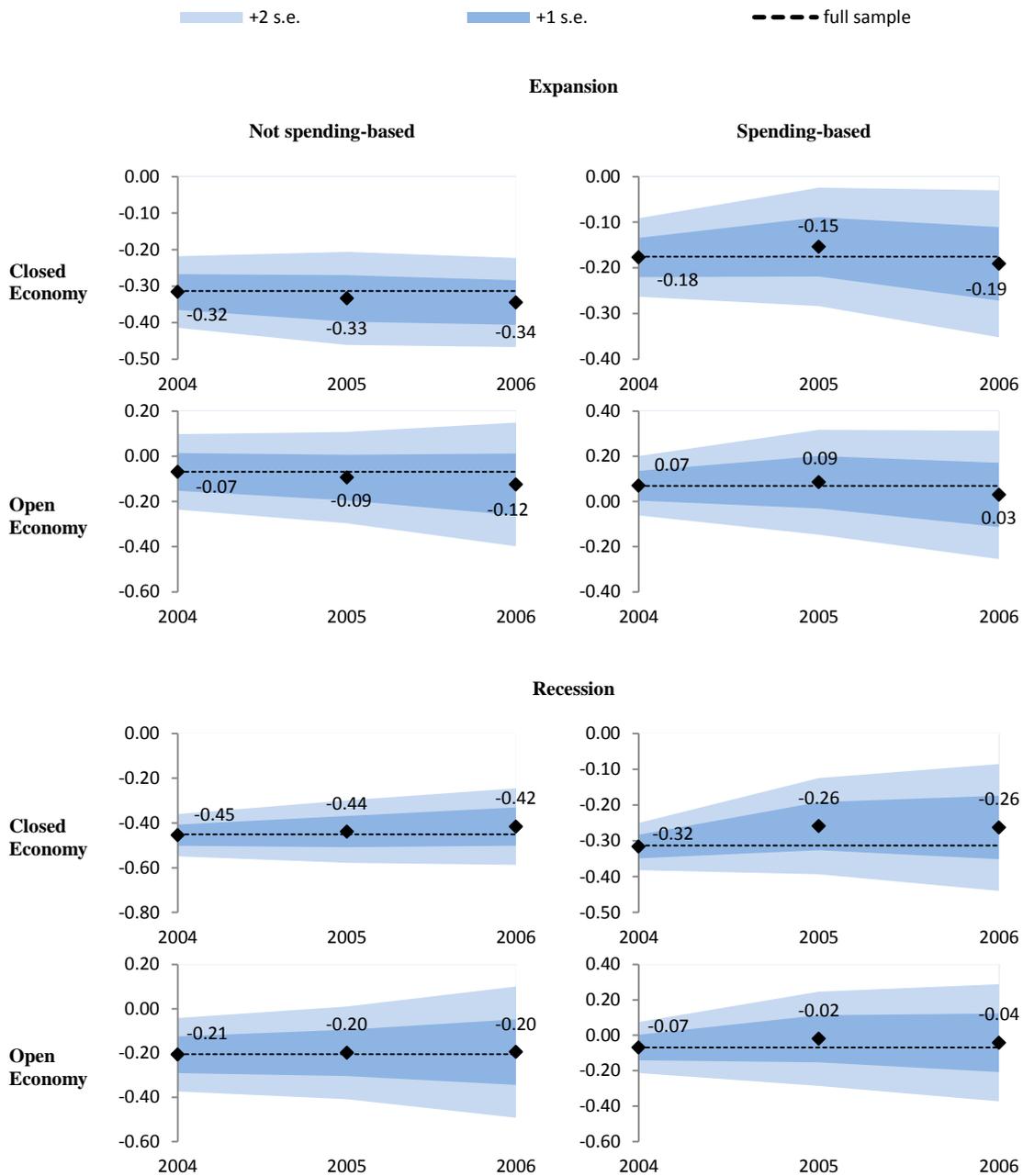
Figure 4 – Robustness of the fiscal multiplier at $t = 3$ (vertical axis) to the exclusion of cross-section i (horizontal axis)
 (Full sample estimates in Table 1, GMM_1, column VII)



Notes: Open economy if the GDP share of exports plus imports exceeds the euro area average. Spending-based if the change in structural primary spending accounts for at least $\frac{3}{4}$ of the total change in the structural primary balance. Recession when real GDP growth < 0 .

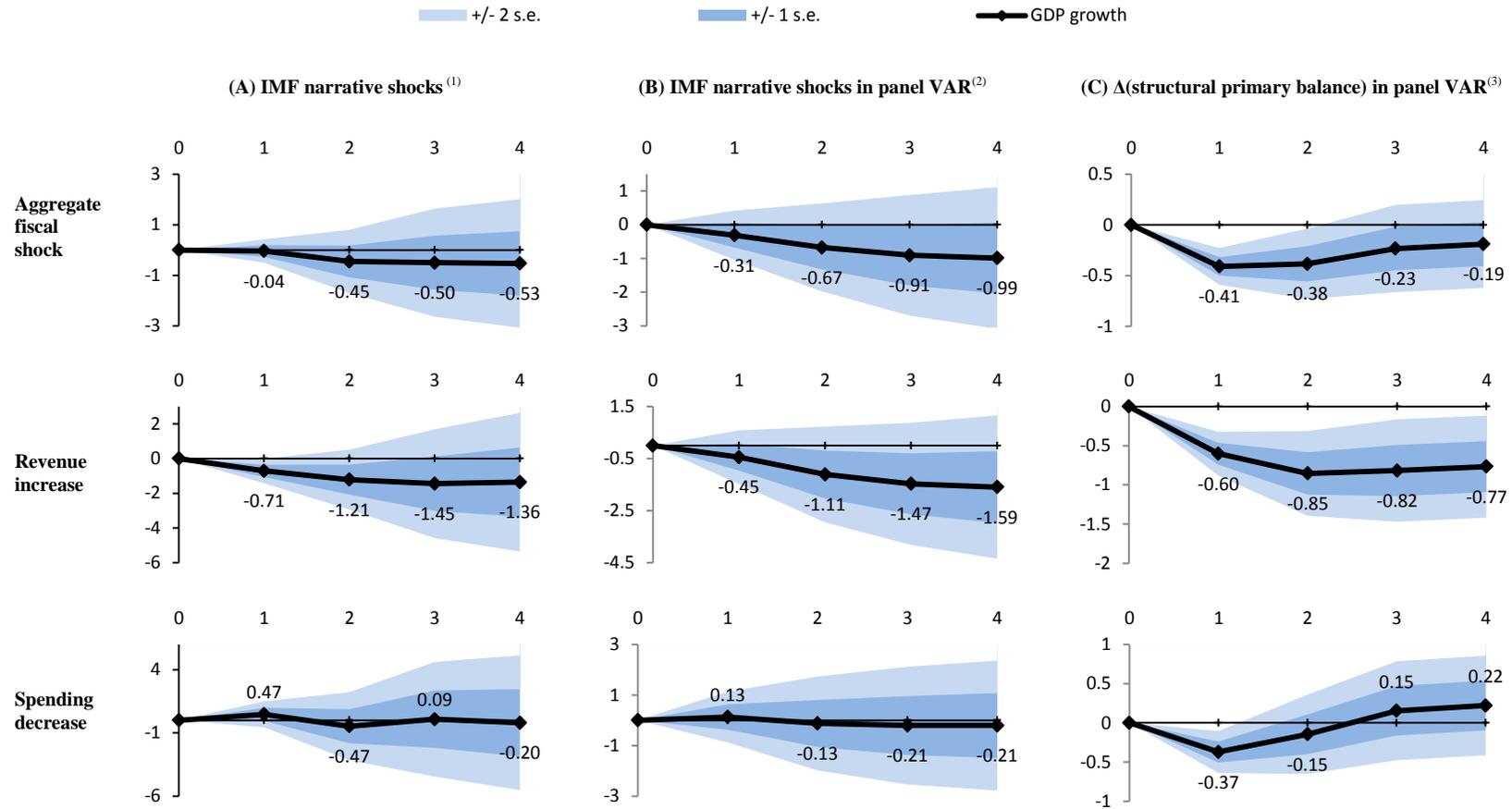
Figure 5 – Robustness of the fiscal multiplier at $t = 3$ (vertical axis) to the estimation starting date (horizontal axis)

(Full-sample values for $t = 0, 1, 2, 3$ are reported in Figure 1)



Notes: The horizontal axis indicates estimation starting date. All estimation ends in 2011. Open economy if the GDP share of exports plus imports exceeds the euro area average. Spending-based if the change in structural primary spending accounts for at least ¼ of the total change in the structural primary balance. Recession when real GDP growth < 0.

Figure 6 – Cumulative response of real GDP growth to: (A) IMF narrative shocks; (B) IMF narrative shocks in a panel VAR; (C) Δ (structural primary balance) in a panel VAR



⁽¹⁾ Using the single equation specification in Guajardo et al (2011), which involves the first two lags of real growth and the current period, first and second lag of the fiscal shocks, while allowing for fixed and period effects.

⁽²⁾ Defined in equation (4) in the text.

⁽³⁾ VAR specification identical to (B).

BANK OF GREECE WORKING PAPERS

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